CLAIMS

What is claimed is:

1. A data storage device, comprising:

a plurality of electron emitters adapted to emit electron beams, each electron emitter having a planar emission surface; and

a storage medium in proximity to the electron emitters, the storage medium having a plurality of storage areas that are capable of at least two distinct states that represent data, the state of each storage area being changeable in response to bombardment by an electron beam emitted by an electron emitter;

wherein data is written to the device by changing the state of the storage areas and data is read by the device by observing phenomena relevant to the storage areas.

2. The device of claim 1, further comprising electron collectors positioned so as to receive secondary and backscattered electrons produced by the storage areas in response to incident electron beams.

3. The device of claim 1, wherein the storage medium is a diode and the storage areas produce minority carriers in response to incident electron beams.

4. The device of claim 1, wherein the electron emitters each comprise a semiconductor layer having an outer surface that forms the emission surface.

5. The device of claim 4, wherein the emission surface occupies an area that comprises a small fraction of the total area of the outer surface.

6. The device of claim 5, wherein the emission surface occupies an area that represents approximately less than 10 % of the total area of the outer surface.

7. The device of claim 4, wherein the semiconductor layer includes a porous region that extends through the semiconductor layer to the emission surface.

8. The device of claim 7, further comprising a substrate on which the semiconductor layer is formed, the substrate having an active region that narrows to a neck that has a cross-sectional area that approximates a cross-sectional area of the porous region.

9. The device of claim 8, wherein the active region has a funnel-like shape.

10. The device of claim 1, further comprising a conductive layer formed on the planar emission surface.

11. The device of claim 10, wherein the conductive layer has a thickness of approximately 10 nanometers or less.

12. The device of claim 10, wherein the conductive layer comprises multiple metal layers.

13. The device of claim 1, further comprising focusing structures that focus electron beams emitted from the electron emitters.

14. The device of claim 13, wherein the focusing structures define apertures through which emitted electron beams pass.

15. The device of claim 14, wherein the focusing structures each include a lens electrode that defines the aperture.

16. The device of claim 1, further including patterning masks that define the planar emission surfaces.

17. The device of claim 1, wherein the electron emitters are metal-insulator-metal (MIM) electron emission structures.

18. The device of claim 1, wherein the electron emitters are metal-insulator-silicon (MIS) electron emission structures.

19. A data storage device, comprising:

means for emitting electron beams, the means including planar emission surfaces; and

means for storing data capable of at least two distinct states that represent data, the state being changeable in response to bombardment by an electron beam emitted by the means for emitting electron beams;

wherein data is written to the device by changing the state of the means for storing data and data is read by the device by observing phenomena relevant to the means for storing data.

20. The device of claim 19, further comprising means for collecting secondary and backscattered electrons produced by the means for storing data in response to incident electron beams.

21. The device of claim 19, wherein the means for storing data comprise a diode that produces minority carriers in response to incident electron beams.

22. The device of claim 19, further comprising means for focusing electron beams emitted from the means for emitting electron beams.

23. A method for storing data, comprising the steps of:

emitting an electron beam from an electron emitter including a planar emission surface;

directing the electron beam toward a storage medium comprising a plurality of storage areas; and

bombarding one of the storage areas with electrons with the electron beam so as to change a state of the storage area.

24. The method of claim 23, wherein the storage area is changed from a crystalline state to an amorphous state.

25. The method of claim 23, wherein the storage area is changed from an amorphous state to a crystalline state.

26. The method of claim 23, further comprising the step of collecting secondary and backscattered electrons produced by the storage area in response to an incident electron beam to determine the state of the storage area.

27. The method of claim 23, further comprising the step of observing the effect on minority carriers produced by the storage area in response to an incident electron beam to determine the state of the storage area.

28. A data storage device, comprising:

a plurality of electron emitters adapted to emit electron beams, the electron emitters each including a substrate having an active region and a semiconductor layer formed on the substrate, the semiconductor layer including a planar outer surface that forms a planar emission surface; and

a storage medium in proximity to the electron emitter, the storage medium having a plurality of storage areas that are capable of at least two distinct states that represent data, the state of the storage areas being changeable in response to bombardment by electron beams emitted by the electron emitters;

wherein data is written to the device by changing the state of the storage areas and data is read by the device by observing phenomena relevant to the storage areas.

29. The device of claim 28, wherein the emission surface occupies an area that represents approximately less than 10 % of a total area of the outer surface.

30. The device of claim 28, wherein the semiconductor layer includes a porous region that extends through the semiconductor layer to the emission surface.

31. The device of claim 28, wherein the substrate has an active region that narrows to a neck that has a cross-sectional area that approximates a cross-sectional area of the porous region.

32. The device of claim 28, further comprising a conductive layer formed on the planar emission surface.

33. The device of claim 32, wherein the conductive layer has a thickness of approximately 10 nanometers or less.

34. The device of claim 32, wherein the conductive layer comprises multiple metal layers.

35. The device of claim 28, further comprising focusing structures that focus electron beams emitted from the electron emitters.